

Listing of Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

1-14. (canceled)

15. (previously presented) A method of processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, comprising:

providing a right channel signal and a left channel signal from said single channel audio signal;

modifying each of said right channel signal and said left channel signal using at least one of a plurality of head response transfer functions ;

introducing a time delay between said right channel signal and said left channel signal to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and

choosing respective values for magnitude of said left channel signal and magnitude of said right channel signal to provide cues for perception of a distance of said source position from said preferred position at said given time; said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener.

16. (previously presented) A method of processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, comprising:

providing a right channel and a left channel, each of said right channel and said left channel carrying said single channel audio signal;

modifying said single channel audio signal of each of said right channel and said left channel using at least one of a plurality of head response transfer functions to provide

a right signal in said right channel for a right ear of said listener and a left signal in said left channel for a left ear of said listener;

introducing a time delay between said right channel and said left channel to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and

choosing respective values for magnitude of said left signal and magnitude of said right signal to provide cues for perception of a distance of said source position from said preferred position at said given time;

said respective values for magnitude of said left signal and said magnitude of said right signal being determined based on an inverse of square of a distance between said source position and respective ears of said listener.

17. (previously presented) A method of processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, comprising:

providing a right channel and a left channel, each of said right channel and said left channel carrying said single channel audio signal;

modifying said single channel audio signal of each of said right channel and said left channel using at least one of a plurality of head response transfer functions to provide a right signal in said right channel for a right ear of said listener and a left signal in said left channel for a left ear of said listener;

introducing a time delay between said right channel and said left channel to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and

choosing respective values for magnitude of said left signal and magnitude of said right signal to provide cues for perception of a distance of said source position from said preferred position at said given time;

wherein said step of choosing respective values for magnitude of said left signal and magnitude of said right signal comprises:

providing a look-up table having therein values of magnitude corresponding to distances between said source position and each of the respective ears of said listener; and

selecting said values for magnitude from said look-up table.

18. (previously presented) The method of processing a single channel audio signal in accordance with claim 16, wherein said step of choosing respective values for magnitude of said left signal and magnitude of said right signal comprises:

selecting a distance from said source position to a center of a head of said listener at said given time; and

determining said distance between said source position and respective ears of said listener based on said inter-aural time difference.

19. (previously presented) The method of processing a single channel audio signal in accordance with claim 18, wherein said step of choosing respective values for magnitude of said left signal and magnitude of said right signal further comprises:

providing a look-up table having therein values of magnitude corresponding to distances between said source position and respective ears of said listener; and

selecting said values for magnitude from said look-up table based on said inter-aural time difference.

20. (previously presented) A method of processing a single channel audio signal as recited in claim 16 wherein at least one of said magnitude of said left signal and said magnitude of said right signal is sufficiently small as to be inaudible.

21. (previously presented) The method of processing a single channel audio signal as recited in claim 16, wherein said left signal and said right signal are compensated to provide at least one of a cancellation and a reduction of transaural crosstalk when said left signal and said right signal are supplied through said left channel and said right channel respectively for replay by loudspeakers.

22. (previously presented) A method of processing a single channel audio signal as recited in claim 16, further comprising:

combining said left signal and said right signal with other two or more channel audio signals.

23. (previously presented) A method of processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, comprising:

providing a right channel signal and a left channel signal from said single channel audio signal;

modifying each of said right channel signal and said left channel signal using at least one of a plurality of head response transfer functions;

introducing a time delay between said right channel signal and said left channel signal to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and

choosing respective values for magnitude of said left channel signal and magnitude of said right channel signal to provide cues for perception of a distance of said source position from said preferred position at said given time; said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener, wherein the respective magnitudes are determined by reference to a lookup table using the inter-aural time delay to determine the respective values for magnitude.

24. (previously presented) A computer readable storage medium having stored thereon a computer program for implementing a method of processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, said computer program comprising a set of instructions for:

providing a right channel signal and a left channel signal from said single channel audio signal;

modifying each of said right channel signal and said left channel signal using at least one of a plurality of head response transfer functions;

introducing a time delay between said right channel signal and said left channel signal to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and

choosing respective values for magnitude of said left channel signal and magnitude of said right channel signal to provide cues for perception of a distance of said source position from said preferred position at said given time; said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to a respective one of the left and right ears of the listener.

25. (previously presented) The computer readable storage medium according to claim 24, wherein:

said respective values for magnitude of said left signal and said magnitude of said right signal are separately determined by using an inter-aural time difference as an input parameter for a lookup table having magnitude values based on the distance from the sound source to the respective one of the left and right ears of the listener..

26. (previously presented) The computer readable storage medium according to claim 24, wherein:

said respective values for magnitude of said left signal and said magnitude of said right signal are determined based on an inverse of square of a distance between said source position and respective ears of said listener.

27. (previously presented) The computer readable storage medium according to claim 24, wherein said set of instructions for choosing respective values for magnitude of said left signal and magnitude of said right signal comprises a set of instructions for:

providing a look-up table having thereon distances between said source position and respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal; and selecting said values for magnitude from said look-up table.

28. (previously presented) The computer readable storage medium according to claim 26, wherein said set of instructions for choosing respective values for magnitude of said left signal and magnitude of said right signal comprises a set of instructions for:

selecting a distance from said source position to a center of a head of said listener at said given time; and

determining said distance between said source position and respective ears of said listener based on said inter-aural time delay.

29. (previously presented) The computer readable storage medium according to claim 28, wherein said set of instructions for choosing respective values for magnitude of said left signal and magnitude of said right signal further comprises a set of instructions for:

providing a look-up table having thereon distances between said source position and respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal; and

selecting said values for magnitude from said look-up table.

30. (previously presented) The computer readable storage medium according to claim 24, wherein:

at least one of said magnitude of said left signal and said magnitude of said right signal is sufficiently small as to be inaudible.

31. (previously presented) The computer readable storage medium according to claim 24, wherein:

said left signal and said right signal are compensated to provide at least one of a cancellation and a reduction of transaural crosstalk when said left signal and said right signal are supplied through said left channel and said right channel respectively for replay by loudspeakers.

32. (previously presented) The computer readable storage medium according to claim 24, wherein said computer program further comprises a set of instructions for:

combining said left signal and said right signal with other two or more channel audio signals.

33. (previously presented) The computer readable storage medium according to claim 32, wherein said set of instructions for combining said left signal and said right signal with other two or more channel audio signals comprises a set of instructions for:

adding respective contents of said left channel and said right channel to corresponding channels of said other two or more channel signals.

34. (previously presented) An apparatus for processing a single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of a listener, comprising:

means for providing a right channel signal and a left channel signal from said single channel audio signal;

means for modifying each of said right channel signal and said left channel signal using at least one of a plurality of head response transfer functions;

means for introducing a time delay between said right channel signal and said left channel signal to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener; and means for choosing respective values for magnitude of said left channel signal and magnitude of said right channel signal to provide cues for perception of a distance of said source position from said preferred position at said given time, said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener.

35. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, wherein:

said means for choosing said respective values is adapted to choose said respective values for magnitude of said left signal and said magnitude of said right signal separately by using an inter-aural time difference as an input parameter for a lookup table having magnitude values based on the distance from the sound source to the respective one of the left and right ears of the listener.

36. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, wherein:

said means for choosing said respective values is adapted to choose said respective values for magnitude of said left signal and said magnitude of said right signal based on an inverse of square of a distance between said source position and respective ears of said listener.

37. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, wherein said means for choosing respective values for magnitude of said left signal and magnitude of said right signal comprises:

a look-up table having thereon distances between said source position and respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal; and

means for selecting said values for magnitude from said look-up table.

38. (previously presented) The apparatus for processing a single channel audio signal according to claim 36, wherein said means for choosing respective values for magnitude of said left signal and magnitude of said right signal comprises:

means for selecting a distance from said source position to a center of a head of said listener at said given time; and

means for determining said distance between said source position and respective ears of said listener based on said inter-aural time delay.

39. (previously presented) The apparatus for processing a single channel audio signal according to claim 38, wherein said means for choosing respective values for magnitude of said left signal and magnitude of said right signal further comprises:

a look-up table having thereon values for distances between said source position and respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal; and

means for selecting said values for magnitude from said look-up table.

40. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, wherein:

at least one of said magnitude of said left signal and said magnitude of said right signal is sufficiently small as to be inaudible.

41. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, further comprising:

compensating means for providing at least one of a cancellation and a reduction of transaural crosstalk in said left signal and said right signal when said left signal and said right signal are supplied through said left channel and said right channel respectively for replay by loudspeakers.

42. (previously presented) The apparatus for processing a single channel audio signal according to claim 34, further comprising:

means for combining said left signal and said right signal with other two or more channel audio signals.

43. (previously presented) The apparatus for processing a single channel audio signal according to claim 42, wherein said means for combining comprises:

means for adding respective contents of said left channel and said right channel to corresponding channels of said other two or more channel signals.

44. (canceled)

45. (previously presented) An audio signal, comprising:

a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time; and

said respective values for magnitude of said left signal and said magnitude of said right signal are chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener.

46. (previously presented) An audio signal, comprising:

a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and

a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time; and

said respective values for magnitude of said left signal and said magnitude of said right signal are determined based on an inverse of square of a distance between said source position and respective ears of said listener.

47. (previously presented) An audio signal, comprising:

a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and

a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time; and

said respective values for magnitude of said left signal and magnitude of said right signal are chosen by selecting said values for magnitude from a look-up table having thereon values for distances between said source position and each of the respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal.

48. (previously presented) The audio signal according to claim 46, wherein:

said respective values for magnitude of said left signal and magnitude of said right signal are chosen by selecting a distance from said source position to a center of a head of said listener at said given time, and by determining said distance between said source position and respective ears of said listener based on said inter-aural time delay.

49. (previously presented) The audio signal according to claim 48, wherein:

said respective values for magnitude of said left signal and magnitude of said right signal are chosen by selecting said values for magnitude from said look-up table having thereon values for distances between said source position and respective ears of said listener, said distances corresponding to associative ones of said values for magnitude of said left signal and said magnitude of said right signal.

50. (previously presented) An audio signal, comprising:

a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and

a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time, said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener; and

said left signal and said right signal are compensated to provide at least one of a cancellation and a reduction of transaural crosstalk when said left signal and said right signal are supplied through said left channel and said right channel respectively for replay by loudspeakers.

51. (previously presented) An audio signal, comprising:

a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and

a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time, said respective values for magnitude of said left channel signal and said magnitude of said right channel signal being chosen separately, each based on the distance from the sound source to the respective one of the left and right ears of the listener; and

said left signal and said right signal are compensated to provide at least one of a cancellation and a reduction of transaural crosstalk when said left signal and said right signal are supplied through said left channel and said right channel respectively for replay by loudspeakers.

52. (previously presented) The audio signal according to claim 45, wherein:
a right signal for a right ear of a listener, said right signal being obtained by modifying a single channel audio signal using at least one of a plurality of head response transfer functions, said single channel audio signal corresponding to a sound from a sound source located at a source position relative to a preferred position of said listener; and

a left signal for a left ear of said listener, said left signal being obtained by modifying said single channel audio signal using at least one of a plurality of head response transfer functions;

wherein said left signal and said right signal having therebetween a time delay to provide cues to perception of a direction of said source position relative to said preferred position of said listener at a given time, said time delay corresponding to an inter-aural time difference of said sound from said sound source with respect to said listener;

respective values for magnitude of said left signal and magnitude of said right signal are chosen to provide cues for perception of a distance of said source position from said preferred position at said given time; and

said left signal and said right signal are combined with other two or more channel audio signals.

53. (previously presented) The audio signal according to claim 52, wherein:

said left signal and said right signal are combined by adding respective contents of said left channel and said right channel to corresponding channels of said other two or more channel signals.